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Evolvable Systems: From Biology to Hardware

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Proceedings



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Preface

In the mid 1990s, researchers began applying Evolutionary Algorithms (EAs) on a kind of computer chip that could dynamically alter the functionality and physical connections of its circuits. This combination of EAs with programmable electronics (e.g., Field Programmable Gate Arrays (FPGAs) and Field Programmable Analogue Arrays (FPAAs)) spawned a new field of Evolutionary Computation (EC) called Evolvable Hardware (EH) with its first workshop, *Towards Evolvable Hardware*, held in Lausanne, Switzerland in October 1995. This workshop was followed by the *First International Conference on Evolvable Systems: From Biology to Hardware (ICES' 96)*, held in Tsukuba, Japan in October 1996. The second ICES was held in Lausanne, September 1998, the third was in Edinburgh, April 2000, the fourth was in Tokyo, October 2001, the fifth was in Trondheim, March 2003, the sixth was in Sitges, September 2005, and the seventh was in Wuhan, September 2007.

Over the years the EH field has expanded beyond the use of EAs on simple electronic devices to encompass many different combinations of EAs and biologically inspired algorithms (BIAs) with various physical devices (or simulations of physical devices). Present research in the field of EH can be split into the two related areas of Evolvable Hardware Design (EHD) and Adaptive Hardware (AH). Evolvable Hardware Design (EHD) is the use of EAs and BIAs for creating physical devices and designs, examples of where EHD has had some success include analogue and digital electronics, antennas, MEMS chips, optical systems as well as quantum circuits. Adaptive Hardware, as the name suggests, uses EAs and BIAs to endow physical systems with some adaptive characteristics. These adaptive characteristics are required to construct more robust components and systems to allow them to continue to operate successfully in a changing environment. For example, a circuit on an FPGA that can “evolve” to heal from radiation damage, or an FPAA that can change its function as operational requirements change.

This year, for the eighth international conference, there were 52 submissions covering topics from the traditional domains of FPGAs and circuit design to applying EH techniques to creating adaptive wireless networks and the design of MEMS devices. These papers were reviewed by our program committee of experts in the field and, based on their reviews, 28 submissions were selected for oral presentation and publication in these conference proceedings. We also include, as shorter papers, 14 submissions that were accepted for poster presentation. Seven of these are extended 10-page poster-papers and the other 7 are shorter 6-page poster-papers. In addition to these published works, ICES 2008 also had four tutorial sessions, three invited talks, and a panel session to further promote the field of Evolvable Hardware. Overall, we think that this collection of papers is a good representation of the research being done in the EH community.

In putting together a conference like this there are many people involved in making it all happen. We would like to thank our Program Committee for their work in reviewing the papers and assisting us in the decision making process and also the ICES Steering Committee for their oversight and commitment to this conference series. We also thank Giovanni Squillero for his work as Publicity Chair. We are also grateful to Milena Zeithamlova and Action M Agency for their work in helping with the organization and running of the conference. In addition, we wish to thank our sponsors: the Faculty of Information Technology, Brno University of Technology, Camea spol. s r.o., TESCOAN, s.r.o., and Honeywell. Finally, we would like to thank all of the authors for the time and effort they put into writing these papers.

As the field of Evolvable Hardware continues to develop and “evolve” to include a wider range of domains, we will need to find ways to overcome two types of challenges. The first challenge is technical, and is similar to that shared by scientists and engineers in all fields, and is that of trying to improve our methods and what we can achieve with them. Here, we must work to develop better biologically-inspired algorithms for search, optimization and adaption. In addition, we must also develop more powerful representations that are better able to encode complex systems in a way that is conducive to biologically-inspired search, optimization and adaptation. The second challenge involves growing our community and connecting with similarly inspired researchers. With the growing popularity and success of Evolutionary Algorithms, and other biologically inspired techniques, many researchers and practitioners in other fields are discovering these techniques and applying them in their own domains. Here our challenge is to continually reach out to these researchers and draw them into our community. From this we hope to share the knowledge gained and learn of promising new methods and application areas.

We hope you enjoy reading the proceedings of the Eighth International Conference on Evolvable Systems as much as we have enjoyed putting the volume together.

June 2008

Gregory S. Hornby
Lukáš Sekanina
Pauline C. Haddow

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